

FORAMINIFERA
FROM
THE RIPLEY FORMATION OF
ALABAMA

ABSTRACT OF

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FORAMINIFERA FROM THE RIPLEY FORMATION IN ALABAMA

JOHN R. SANDIDGE

INTRODUCTION

Microscopic fossils furnish an accurate and convenient means of establishing stratigraphic relationships. That foraminifera are especially useful for this purpose was recognized by European paleontologists as early as the first part of the nineteenth century, when the classic works of d'Orbigny, Ehrenberg, and others began to appear. The foraminifera have been studied more or less continuously since that time, and today there are many students of both fossil and living material. Few comprehensive systematic works comparable to those of the early European paleontologists have been published by American investigators, however, and until recently the field has been to a large extent undeveloped in this country.

The foraminiferal faunas of the Upper Cretaceous in the Gulf Coastal Plain lately have received marked attention, and much information has been added to our knowledge of them.

Especially have many significant facts been contributed about the faunas of the western and central portions of the Gulf Embayment, where close correlations undoubtedly soon may be anticipated. The notable progress which recently has been made in the publication of data on these western and central exposures, however, has not been attained in the equally interesting and important southeastern extension of this great arc of Cretaceous sediments. It is with the object of furnishing information on the foraminiferal faunas particularly of these southeastern deposits that this paper has been prepared.

Studies made in the field have covered a large part of the Cretaceous belt, extending from Georgia to Mississippi. Altogether over 300 stations were established from which more than 1000 samples have been obtained. The localities from which the accompanying species were obtained are as follows:

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FOSSIL LOCALITIES.

Barton's Bluff, Locality 53. About eight miles above Moscow on the Tombigbee River there is an exposure of some 60 feet in which both the Selma chalk and the Ripley occur. This is a fault zone where vertical displacement has brought the two facies into juxtaposition. The Ripley at this point is highly calcareous, but presents the usual sandy, glauconitic aspect as well, and is very similar to the exposure at the mouth of Boguechitto Creek. It contains a rich foraminiferal fauna.

Prairie Bluff, Locality 87. This locality on the Alabama River, made classic by the early work of Toumey,² Winchell,³ and Smith,⁴ is about six miles southeast of the town of Catherine, Wilcox County, and may be reached by a local road from this village to the old Prairie Post Office. The exposure forms a bluff about 100 feet high with the strata dipping at the unusual rate of 300 feet to the mile. At the top there is a blue limestone containing *Exogyra costata* Say, *Gryphea vesicularis* Lamarck, and large numbers of phosphatized shell casts. It has a thickness of 8 to 10 feet. Below this stratum there occurs a sandy-chalk deposit approximately 20 feet thick. The lower part of this bed, near the middle of the bluff, is marked by a hard ledge made up largely of shells. The remainder of the exposure, extending to water level, consists of beds of loose richly glauconitic, slightly argillaceous sands alternating with indurated ledges of the same materials, apparently cemented by calcareous deposits. Macrofossils occur frequently but are not abundant. The foraminifera found at this locality are uniformly small, and a few species are represented. The fauna occurring in the sandy beds is especially impoverished. This is Upper Ripley.

Rocky Bluff, Locality 88. One mile above Prairie Bluff on Alabama River there is an exposure of Ripley in a low cliff, called Rocky Bluff by Smith. Only the basal part, about 15

feet in thickness, has been examined, since the upper beds are the same as those at Prairie Bluff. These lower strata appear to be a downward continuation of the alternating soft sands and indurated ledges of the lower part of the exposure at Prairie Bluff. They have similar steep dips, and probably in both cases these may be attributed to depositional slopes. Macrofossils are present but not abundant. A restricted foraminiferal fauna has been found.

Pine Barren Creek, Locality 104. Half a mile above the mouth of Pine Barren Creek there is a bluff, about 15 feet high, exposing Ripley strata. At the top there are 5 feet of gray micaceous sand and clay, and below this, 10 feet of black micaceous clay. The gray beds contain foraminifera in abundance, while only a sparse fauna is present in the black sediments.

Red Bluff, Locality 105. Just north of the boundary between Wilcox and Dallas counties on Alabama River there is a remarkably high bluff in the lower part of which 40 to 50 feet of Ripley are exposed. This deposit is massively bedded, and consists of alternating layers of dark-blue micaceous clay, and clay containing varying amounts of fine sand. The clay is predominant. Large fossils are present, but not abundant. A rich microfauna has been found. The horizon appears to be low in the Ripley of this region.

Boguechitto Creek, Locality 106. A low bluff occurs at the point where Boguechitto Creek joins Alabama River, and a fault brings the chalk up against the lower Ripley beds. The displacement appears to be about 25 feet. The Ripley strata are typical calcareous ledges, and contain numerous macrofossils. The microfauna from this horizon is exceedingly rich and well-developed. The upper part of the chalk exposed at this locality contains *Exogyra costata* and *E. ponderosa*. It has a great many foraminifera, but the fauna does not appear to be as rich as that of the immediately overlying Ripley beds.

RELATIONSHIPS OF THE FAUNA

The foraminifera of the Ripley formation in Alabama, in general, bear a close relationship to the Cre-

² Toumey, M., First Bien. Rept., Ala. Geol. Survey, 1850.

³ Winchell, A., Proc., Am. Assn. Adv. Sci., vol. 10, p. 90, 1856.

⁴ Smith, Eugene A., Geology of the Coastal Plain of Alabama, Ala. Geol. Survey, Rept., 1894; U. S. Geol. Survey, Bull. 43, p. 189.

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taceous faunas of neighboring regions, especially to those of the central and western part of the Gulf Coastal Plain. A number of species common in the Navarro and Taylor formations of Texas have been found, as well as many forms characteristic of the Velasco shale of Mexico. The Saratoga chalk fauna of Arkansas is well represented, and practically all of the species from the Ripley of Tennessee occur in Alabama. A most striking parallelism with the fauna from the Cretaceous marls of the Bavarian Alps⁵ is apparent, and there is marked similarity to the European Cretaceous faunas described by d'Orbigny and Reuss. Several species now living in the shallower waters of the Caribbean and the Gulf of Mexico are present, and the occurrence of these, together with the presence of a large proportion of species common in the Mediterranean Cretaceous, suggests that the Ripley sea was moderately warm, or warm temperate, and shallow. Analytical comparisons of the Ripley species with those of other regions cannot be presented at this time because the accompanying fauna is in no measure complete, including only a small proportion of the forms encountered at the localities represented. The results are qualitative, rather than quantitative, and a thorough analysis of the fauna must await further study and more extensive means of publication.

STRATIGRAPHY

The Upper Cretaceous of the

⁵ Egger, *Abh. d. II, Cl. d. k. Akad. d. Wiss.*, Wien, XXI, Bd. I, Abth. 1893.

Southeastern States consists of sedimentary deposits, made up of beds of sand, gravel, clay, and chalk. Most of these beds were formed in comparatively shallow marine waters, but some of the coarser, irregularly-bedded materials were deposited by streams on a low coastal plain. In Alabama, Stephenson, in his latest work,⁶ divides these sediments into four formations. In ascending order they are the Tuscaloosa formation, the Eutaw formation, the Selma chalk, and the Ripley formation. On the whole these strata dip uniformly southward or southwestward toward the Gulf at an inclination of only one or two degrees, except where local disturbances of the beds have produced abnormalities. For the most part the Cretaceous strata in Alabama are monotonously flat.

The Ripley formation was named by Hilgard⁷ in 1860 for the town of Ripley in Tippah County, Miss., which is near the typical fossiliferous exposures on Owl Creek. In the eastern part of the Cretaceous outcrop the Ripley beds may be traced from Twiggs County in central Georgia to western Alabama, near Livingston in Sumter County, where they pass into the upper portion of the Selma chalk. From this locality northward to Houston County, Miss., the chalk forms the top of the Upper Cretaceous, but here the Ripley reappears, and extends from this place across

⁶ Stephenson, L. W., "Geology of Alabama," Special Report No. 14, Alabama Geological Survey, 1926, p. 231.

⁷ Hilgard, E. W., "Report on the geology and agriculture of Mississippi," pp. 62, 83-95, 1860.

Tennessee and Kentucky into southern Illinois. The outcrop at the Georgia line has a width of 30 miles, and narrows gradually westward to the eastern boundary of Lowndes County, Alabama, where the distance across the exposure is 16 miles. It then decreases in width more rapidly and disappears a short distance east of Livingston. The northwestern exposure varies in width from 12 to 6 miles. The maximum thickness of the formation, which occurs near the eastern boundary of the State and gradually diminishes westward to Livingston, is approximately 1,000 feet. Only that portion of the Ripley which lies on the eastern side of the chalk and within the boundaries of Alabama is considered in this investigation.

In its typical development the Ripley formation consists principally of rather thick-bedded, dark-gray sands, which usually are more or less calcareous, micaceous, pyritiferous, glauconitic, and argillaceous. Mega-fossils generally are abundant, and in some localities they are numerous enough to constitute a shell marl. Micro-fossils do not occur as unfailingly as do the larger shells, and several beds have been found in which the foraminifera are exceedingly rare or altogether lacking. This is particularly true of certain nearly pure sand strata, and of some rich marl beds in the eastern part of the State. In fact it is possible to trace a gradual diminution of the micro-fauna from west to east, although not all of the beds in the west carry the small fossils, and

some of those in the east always have them. Sandstone ledges are a characteristic feature of all the Ripley outcrops in Alabama except in the case of the Providence sand member, and the basal strata of the extreme eastern part of the State. The lower extremities of the formation by scarcely perceptible stages interfinger with and merge into the Selma chalk.

The abundance of fossils in both the Selma chalk and the sandy Ripley deposits indicates that conditions for invertebrate life were unusually favorable in the late Cretaceous sea. A copious supply of food brought in by numerous streams from the land to the north, the quiet lagoons which undoubtedly bounded the coast much as they do today, and the warm, shallow waters of the open sea afforded a combination of environmental factors that appears to have approached the optimum for many forms. Stephenson⁸ has obtained over 200 species of invertebrates, mostly Mollusca, with Ostreidae predominant, from the Selma chalk and the Ripley. These same rocks in some localities are teeming with the remains of microscopic organisms, and the purer phases of the chalk, as has been shown by Cunningham,⁹ are largely made up of foraminifera. This early microscopist records 41 species¹⁰ of foraminifera from the Selma, and the present investigation indicates that this num-

⁸ Stephenson, I. W., U. S. Geol. Surv., Prof. Paper No. 81, 1914.

⁹ Cunningham, K. M., in "Geology of the Coastal Plain of Alabama." Ala. Geol. Surv. Rept., 1894, p. 286.

¹⁰ Idem. Identified by Anthony Woodward of New York.

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ber may be greatly increased upon further study. The Ripley sand and marls alone have yielded nearly 100 foraminiferal species, and there is reason to believe that this number also may be materially increased with further study of these sediments.

ACKNOWLEDGMENTS

The material upon which the work presented herewith is based was collected during the summer of 1927 with the approval and cooperation of the Alabama Geological Survey. Through the good offices of Dr. Walter B. Jones, at that time Assistant State Geologist, and the late Dr. Eugene A. Smith, State Geologist, ample facilities for the preliminary preparation of samples were provided, and such other requirements as were essential to assembling an abundance of good material were readily met. It is hoped that the present work may be the first of a series of faunal studies which in time will be incorporated into a monograph on the Cretaceous foraminifera of Alabama.

Assistance in preparing for the task of studying foraminifera was received from Dr. Joseph A. Cushman, who accommodated the writer in his private laboratory for a period of five

weeks. During this time much valuable instruction was received, and innumerable needs of the present work were anticipated. The writer expresses gratitude for Dr. Cushman's generosity in this respect, and also for further assistance in solving some difficult problems of identification. The author is indebted to Mrs. Helen Jeanne Plummer, of Austin, Texas, for suggestions, for the use of slides containing type specimens from various parts of the Gulf Embayment, and for the contribution of faunal lists from many formations of the Southwest.

The possibilities of research on the foraminifera were suggested to the writer by Professor Edward W. Berry, and the study was largely carried on under his direction and supervision. He gave much valued criticism, and suggested many important ideas incorporated in the investigation. His works on the Cretaceous of the Southeast have been drawn on freely for information bearing upon the problem. Inspiration and encouragement were received from Professors E. B. Mathews and J. T. Singewald, Jr., and from other members of the Geology Department at Johns Hopkins University.

DESCRIPTION OF SPECIES*

Family TEXTULARIDAE

Genus TEXTULARIA Defrance

TEXTULARIA RIPLEYENSIS Berry

Plate 41, figures 6-8

Textularia ripleensis WILLARD BERRY, 1929,

in Berry and Kelley, U. S. Nat. Mus., Proc., vol. 76, Art. 19, pl. 2, fig. 2.—Cushman, 1931, Tenn. Geol. Surv., Bull. 41, p. 19, pl. 1, figs. 6, 7.

Test much compressed, initial portion slightly bulbous in shape, apertural end wide and flattened on top, margin sharp, serrate: chambers

* Reprinted from the *Journal of Paleontology*, vol. 6, No. 3, pp. 267-287, pls. 41-44, September, 1932.

numerous, 8-9 on each side, low, long, somewhat inflated, overlapping slightly at the middle of the test, sloping downward and laterally from the axis, tapering to the outer end which is frequently projecting; sutures deeply impressed, usually indented at the margin; wall finely arenaceous; aperture a small arched opening at the base and inner end of the last-formed chamber with a short lobe on each side. Length of illustrated specimen, 0.75 mm.

Genus BIGENERINA d'Orbigny

BIGENERINA RIPLEYENSIS Sandidge, n. sp.

Plate 41, figures 4, 5

Test elongate, later portion cylindrical, early part compressed, made up of several biserial chambers, wider than earliest uniserial portion, later chambers increasing slightly in size as added; sutures indistinct both in later portion and in the early biserial part; wall coarsely arenaceous, rough; aperture a terminal, rounded opening in the last chamber. Length of the holotype, 1.3 mm.

Family VERNEUILINIDAE

Genus GAUDRYINA d'Orbigny

GAUDRYINA PUPOIDES d'Orbigny

Plate 41, figure 1

Gaudryina pupoides D'ORBIGNY, 1840, Mém. Soc. géol. France, vol. 4, p. 44, pl. 4, figs. 22-24; 1846, Foram. foss. Bassin tert. Vienne, p. 197, pl. 21, figs. 34-36.—CHAPMAN, 1926, New Zealand Geol. Surv., Pal. Bull. 11, p. 34, pl. 8, fig. 6.

Test elongate, somewhat conical, tapering from a broad and rounded apertural end to a rather sharply pointed initial end, slightly twisted, early triserial portion short and

somewhat rounded, later biserial part inflated, only slightly compressed; chambers in triserial portion small, rounded, biserial series gradually increasing in size as added and becoming more inflated, last pair large and much inflated; sutures in early stages indistinct, later becoming definite and deeply impressed; wall coarsely arenaceous, very smoothly finished; aperture a narrow, rectangular slit at the base and inner edge of the last-formed chamber. Length of illustrated specimen, 0.8 mm.

GAUDRYINA OXYCONA Reuss

Plate 41, figures 2, 3

Gaudryina oxycona REUSS, 1860, Sitz. Akad. Wiss. Wien, vol. 40, p. 229, pl. 12, figs. 3a-c.—CUSHMAN AND CHURCH, 1929, Proc. Calif. Acad. Sci., ser. 4, vol. 18, p. 501, pl. 56, figs. 3, 4.—CUSHMAN, 1931, Jour. Pal., vol. 5, p. 300, pl. 34, figs. 4a, b.

Test short, conical, rounded at the initial end, circular in section; chambers triserial in early stages only, biserial chambers flat and wedge-shaped, semicircular in plane view; wall rather thick, coarsely arenaceous smoothly finished; aperture a narrow slit situated in an elongate indentation at the middle of the inner margin of the last chamber. Length of the illustrated specimen, 0.6 mm.

GAUDRYINA STEPHENSONI Cushman

Plate 41, figures 13, 14

Gaudryina stephensoni CUSHMAN, 1928 Contr. Cush. Lab. for Foram. Res., vol. 4, pt. 4, p. 103, pl. 16, figs. 6-8; 1931 Tenn. Geol. Surv., Bull. 41, p. 20, pl. 1, figs. 11a, b.

Test elongate, tapering, tooth-like, sides flattened or slightly concave, angles sharp, marked by a row of small fistulae, initial end pointed,

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sometimes curved, tripyramidal, apertural end rather broad and flattened or very slightly arched; chambers numerous, 8 to 10, first 3 or 4 triserial, later ones biserial, wedge-shaped, overlapping, quadrate in section; sutures sometimes slightly impressed, usually indistinct; wall finely arenaceous, smooth except along the lateral angles, which are jagged due to broken fistulose processes; aperture at the inner edge of the last-formed chamber, small, round, not protruding. Length of figured form, 0.6 mm.

This species was originally described by Cushman from the Taylor formation of Texas, and has since been found by him in the Selma chalk of Tennessee. Present knowledge indicates that the form is confined to the lower and middle portion of the Ripley formation in Alabama.

Genus *HETEROSTOMELLA* Reuss

HETEROSTOMELLA CUNEATA Sandidge, n. sp.

Plate 41, figures 11, 15, 16

Test elongate, tapering, cuneiform, sides flattened or slightly concave, initial end pointed, tripyramidal, apertural portion quadrilateral, apertural face broad and slightly arched, angles marked by a row of small fistulae; chambers variable in number, eight in the holotype, first few triserial, later ones becoming biserial, low, flat; sutures not clearly defined, sometimes slightly impressed; wall finely arenaceous, surface irregular; aperture terminal, located near the middle of the last-formed chamber, small, round, with a short tube-like

neck. Length of holotype, 0.45 mm.

This species is very similar to *Gaudryina stephensoni* Cushman⁶ of the same fauna, and bears a superficial resemblance to some of the Boli-vinitas. The siphon-like character of the aperture distinguishes it from the former, while this feature, together with the triserial early chambers, the jagged appearance of the angles, and the arenaceous character of the test make differentiation easy in the latter case.

This new *Heterostomella* has been found in the lower part of the Ripley formation at Barton's Bluff on Tom-bigbee River and in the upper Ripley at Prairie Bluff on Alabama River. It occurs frequently at the former locality but only rarely at Prairie Bluff. The holotype is from Barton's Bluff (Locality 53).

Genus *CLAVULINA* d'Orbigny

CLAVULINA PARISIENSIS d'Orbigny

Plate 41, figure 12

Clavulina parisiensis d'ORBIGNY, 1826, *Modèle*, No. 66.—TERQUEM, 1882, *Mém. Soc. géol. France*, ser. 3, vol. 2, p. 121, pl. 12 (20), figs. 34a, b.—H. B. BRADY, 1884, *Rep. Voy. Challenger*, Zoology, vol. 9, p. 395, pl. 48 figs. 14–18.—EGGER, 1893, *Abh. kön. bay. Akad. Wiss. München*, Cl. II, vol. 18, p. 274, pl. 6, fig. 44.—FLINT, 1897, *Ann. Rep. U. S. Nat. Mus.*, p. 289, pl. 35, figs. 2, 3.—CUSHMAN, 1911, *U. S. Nat. Mus., Bull. No. 71*, p. 75, figs. 123–124 (text); 1921, *U. S. Nat. Mus., Bull. No. 100*, p. 156, pl. 19, fig. 4.

Test elongate, slender, triserial in early portion, sharply angled, pointed, later portion uniserial, cylindrical, increasing gradually in size to the last few chambers which may

⁶ Cushman, J. A., *Contr. Cushman Lab. Foramin. Research*, vol. 4, pt. 4, p. 108, pl. 16, figs. 6–8, 1928.

be slightly inflated; chambers numerous, number variable; sutures in early part indistinct, in later portion distinct and impressed; wall coarsely arenaceous, surface usually rough; aperture round, central, terminal on face of last-formed chamber; with small valve or tooth. Length of figured specimen, 1.5 mm.

The Ripley representatives of this species appear to be somewhat coarser in texture, and to have chambers slightly larger than most specimens figured in the literature. In other respects this Ripley test follows closely the type. So far as is now known, its occurrence is limited to

the lower and middle portion of the formation in the Alabama River section, where it is fairly abundant.

CLAVULINA PLUMMERAE Sandidge, n. sp.
Plate 41, figures 17, 18

Test elongate, triangular in early stages, rounded in final stages, tapering at the round apertural end and at pointed initial end, sides approximately parallel in intermediate portion; chambers triserial in early stages, uniserial in later stages; angles in early chambers sharply carinate, less sharp on intermediate chambers, final chambers non-carinate and rounded; sutures indistinct

EXPLANATION OF PLATE 41

- FIGS. 1—*Gaudryina pupoides* d'Orbigny, $\times 45$. Specimen from Rocky Bluff, Locality 88. Side view, showing inflation of chambers.
- 2, 3—*Gaudryina oxycona* Reuss, $\times 45$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 2, Side view, showing conical shape of test and wedge-shaped chambers. 3, Top view, showing position of aperture and circular cross-section.
- 4, 5—*Bigenerina ripleyensis* Sandidge, n. sp., $\times 45$. Specimens from exposure at the mouth of Boguechitto Creek, Locality 106. 4, Longitudinal section, showing early biserial and later uniserial arrangement of chambers. 5, Exterior of the holotype, showing large size and rough character of the test.
- 6, 7, 8—*Textularia ripleyensis* Berry, $\times 40$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 6, Side view, illustrating inflation of the chambers. 7, View from above, showing cross-sectional shape. 8, Edge view, showing position and character of the aperture.
- 9, 10—*Dorothyia bulletta* (Carsey), $\times 36$. Specimen from exposure at the mouth of Boguechitto Creek. 9, Edge view, showing apertural face. 10, Side view, illustrating inflation of the test.
- 12—*Clavulina parisensis* d'Orbigny, $\times 28$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 13, 14—*Gaudryina stephensoni* Cushman, $\times 40$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 13, Edge view, showing aperture. 14, Side view, illustrating the fistulose angles.
- 11, 15, 16—*Heterostomella cuneata* Sandidge, n. sp., $\times 90$. Holotype from Barton's Bluff, Locality 53. 11, Top view, giving cross-sectional shape, and position of aperture. 15, View from back, showing flat wall. 16, Front view, illustrating triserial-biserial arrangement, and fistulose angles.
- 17, 18—*Clavulina plummerae* Sandidge, n. sp., $\times 28$. Holotype from Barton's Bluff, Locality 53. 17, Side view, showing rounded and inflated final chamber. 18, End view, giving cross-sectional shape and character of aperture.
- 19, 20—*Robulus cultratus* Montfort, $\times 28$. Specimen from Red Bluff, Locality 105. 19, Side view, illustrating wide keel. 20, Peripheral view, showing aperture.
- 21—*Bolivina incrassata* Reuss, $\times 45$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 22—*Cornuspira cretacea* Reuss, $\times 40$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.



Sandidge, Cretaceous Foraminifera

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in early portion of test, slightly arched in first uniserial stages, later becoming horizontal and deeply impressed; wall finely arenaceous, rather smoothly finished; aperture rounded, central and terminal on last chamber. Length of the illustrated holotype, 1.6 mm.

This species differs from *Clavulina insignis* Plummer, or *C. trilatera* Cushman, in having its later chambers, particularly the final one, inflated and non-carinate, and the sides of the middle portion of the test practically parallel. It also has an aperture which is consistently rounded, and not trifurcate.

Description of the species is based on specimens which came from Barton's Bluff, on Alabama River (Locality 53). It is named for Helen Jeanne (Mrs. F. B.) Plummer.

Family VALVULINIDAE

Genus DOROTHIA Plummer

DOROTHIA BULLETTA (Carsey)

Plate 41, figures 9, 10

Gaudryina bulletta CARSEY, 1926, Univ. of Texas, Bull. 2612, p. 28, pl. 4, fig. 4.

Dorothia bulletta PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 132, pl. 8, figs. 13-17.

Test short, stout, nearly circular in horizontal section, initial end conical, ultimate end slightly compressed; chambers in early stages coiled, four or more chambers in a whorl, later three chambers to a whorl, and finally a biserial arrangement is assumed; sutures fine and indistinct in early portion of test, impressed between later chambers; wall smoothly arenaceous; aperture elongate, slightly arched, at the inner

edge of the base of the last chamber. Length of illustrated specimen, 0.75 mm.

Family OPHTHALMIDIIDAE

Genus CORNUSPIRA Schultze

CORNUSPIRA CRETACEA Reuss

Plate 41, figure 22

Cornuspira cretacea REUSS, 1862-1863, Sitz. Akad. Wiss. Wien, vol. 46, p. 34, pl. 1, fig. 10.—EGGER, 1899, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, p. 18, pl. 22, figs. 1, 2.—CUSHMAN, 1926, Bull. Am. Assn. Petroleum Geol., vol. 10, p. 608, pl. 21, figs. 3a, b.—WHITE, 1928, Jour. Pal., vol. 2, p. 188, pl. 27, fig. 9.—CUSHMAN, 1931, Tenn. Geol. Surv., Bull. 41, p. 24, pl. 2, fig. 7.

Cornuspira involvens WILLARD BERRY, 1929, in Berry and Kelley, U. S. Nat. Mus., Proc., vol. 76, art. 19, p. 15, pl. 1, fig. 15.

Test composed of a long tube, closely coiled around the proloculum, increasing in size with length; oval in shape, bilaterally symmetrical, concave at the center; wall smooth, white; aperture at the end of the tube. Diameter of figured specimen, 0.75 mm.

Family LAGENIDAE

Genus ROBULUS Montfort

ROBULUS CULTRATUS Montfort

Plate 41, figures 19, 20

Robulus cultratus MONTFORT, 1808, Conch. Syst., vol. 1, p. 214, 54 genre.

Robulina cultrata D'ORBIGNY, 1826, Ann. Sci. Nat. vol. 7, p. 287, No. 1; 1846, Foram. Foss. Bass. Tert. Vienne, p. 96, pl. 4, figs. 10-13.

Cristellaria cultrata CHAPMAN, 1926, New Zealand Geol. Surv., Pal. Bull. 11, p. 61, pl. 1, fig. 6; pl. 4, figs. 9a, b, 15a, b, 27a, b, 30a, b, 31.

Test close-coiled, compressed, umbonate, periphery bearing a thin, broad, nearly transparent keel; chambers numerous, 12 or more in the last-formed coil, narrow, slightly

curving, somewhat overlapping; sutures appearing as narrow curving lines, radiation from a large central boss, usually not raised above the surface of the test; wall smooth, polished, thin, umbilical area covered with a large knob of transparent shell material; apertural face triangular, usually with a narrow rim at the sides; aperture at the peripheral angle, outer edge usually radiate, a slit extending well down into the apertural face. Diameter of illustrated form, 1.5 mm.

The well-preserved specimens of this species from the Ripley formation correspond quite closely to many of the figures in the literature. They are strikingly similar to the European forms figured by d'Orbigny and Reuss. The resemblance to *Cristellaria iota* Cushman⁷ is very evident, but the two are distinguished on the basis of size and apertural characterization. Mrs. Plummer's *Cristellaria navarroensis* is regarded as a close relative. *Robulus cultratus* differs from it in being usually larger, in having more chambers, and a much wider keel.

ROBULUS ALDRICHI Sandidge, n. sp.

Plate 42, figures 3, 4

Test close-coiled, somewhat elongate, moderately compressed, umbonate, peripheral margin distinct, bordered by a narrow rim, chambers gently curving, 8 or 9 in last whorl, sutures limbate in early part of coil, later becoming smooth, curving out-

ward from central boss; wall smooth; apertural face flat, triangular, bordered by a narrow rim; aperture at the apical angle, oval, with a few radial striations around the peripheral edge, lower portion extending into the apertural face. Diameter of holotype, 0.7 mm.

This remarkably characteristic representative of Montfort's early genus is closely related to *Cristellaria degolyeri* Plummer⁸ described from the Texas Midway. The rimmed, bead-like periphery, and the very definite variation in the type of the aperture are the chief means of differentiation. This occurrence of the robuline representative in the Ripley leads to speculation regarding the ancestry of the Midway form.

The holotype is from Red Bluff, on the Alabama River (Locality 105).

This species is named for Dr. Truman H. Aldrich, paleontologist at the Alabama Museum of Natural History.

Genus LENTICULINA Lamarck

LENTICULINA IOTA (Cushman)

Plate 42, figures 24, 25

Cristellaria cultrata H. B. BRADY (not Montfort), 1884, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 550, pl. 70, figs. 4-6.—EGGER, 1893, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 352, pl. 12, figs. 8-10, 24, 25; 1899, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, Bd. 1, p. 123, pl. 21, figs. 11, 12.
Cristellaria iota CUSHMAN, 1923, U. S. Nat. Mus. Bull. No. 104, pt. 4, p. 111, p. 129, fig. 2; pl. 30, fig. 1.

Test close-coiled, compressed, umbonate, the periphery with a broad keel, nearly transparent, 13-15 chambers in the last-formed

⁷ Cushman, J. A., U. S. Nat. Mus., Bull. 104, pt. 4, 1923, p. 111, pl. 29, fig. 2; pl. 30, fig. 1.

⁸ Plummer, Helen Jeanne, Univ. Tex., Bull. 2644, 1926, p. 97, pl. VII, figs. 7a, b.

coil, narrow; sutures slightly curved, very slightly limbatè but not raised above the general surface, umbonal region occupied by a large thickened transparent knob, wall smooth, thin; aperture radiate, at the peripheral angle of the test, those of the early chambers distinct throughout the last formed coil.—*Cushman*.

This description of the Recent form from the Atlantic and Gulf of Mexico applies very aptly to the specimens from the Ripley formation. Diameter of figured specimen, 2.25 mm. The fossil representatives are not so transparent as the Recent ones, and there seems to be somewhat greater limbation of the sutures in these forms. Otherwise they closely resemble the figures of the Recent species.

LENTICULINA JONESI Sandidge, n. sp.

Plate 42, figures 1, 2

Test close-coiled, somewhat longer than broad, periphery acute, sometimes slightly keeled; chambers comparatively few, usually 6 to 8 in the last whorl, slightly curving, somewhat inflated; sutures gently curving lines, sometimes slightly impressed, especially between the last few chambers; wall smooth; apertural face rounded, not sharply truncate, triangular in its general shape; aperture at the peripheral angle, somewhat protruding, radiate. Diameter of holotype, 0.75 mm.

This species has been established to care for the many forms occurring in the Ripley which resemble in their general appearance *L. gibba*, but which cannot be grouped with it because of their persistently different apertural face. Whereas *L. gibba* has

a truncate apertural face with a rimmed margin, that of *L. jonesi* is inflated and rounded. It resembles in some respects Cushman's *L. d'orbigny*, but differs from that form in the shape of the apertural face, in having slightly curving chambers and sutures, and in being smaller. *Robulina subangulata* of Reuss is a closely related species, found in the Cretaceous of Europe, from which the Ripley form is differentiated only by the character of its aperture.

The holotype is from Rocky Bluff, on the Alabama River (Locality 88).

This species is named for Dr. Walter B. Jones, state geologist of Alabama.

Genus *DENTALINA* d'Orbigny

DENTALINA CONFLUENS Reuss

Plate 42, figure 9

Dentalina confluens REUSS 1861, (1862), Sitz. d. k. Akad. Wiss., Wien Bd. 44, No. 21, p. 335, pl. 7, fig. 5.—CUSHMAN, 1931, Jour. Pal. vol. 5, p. 304, pl. 35, fig. 1.

Nodosaria confluens EGGER, 1899 (1902) Abh. d. II, Cl. d. k. Akad. Wiss. XXI, Bd. 1, Abth., München, p. 72, pl. 9, figs. 27, 28.

Test elongate, moderately slender, very slightly tapering, a short, stout spine at the aboral end; chambers in early portion of test about as broad as long, nearly uniform in size, later ones longer, slightly inflated, numerous, from 8 to 10; sutures indistinct between early chambers, constricted toward the apertural end of the test; wall ornamented with from 10 to 12 sharp, occasionally discontinuous, longitudinal costae extending from apical spine to aperture, early ones slightly twisted; aperture eccentric, at the end of a tapering neck. Length, 1.2 mm.

DENTALINA REUSSI Neugeboren
Plate 42, figure 10

Dentalinareussi NEUGEBOREN, 1850, Verhandl. und Mittheil. d. Siebenbürgischen Vereins Nat. Wiss. zu Hermannstadt; 1856, Denkschr. d. k. Akad. Wiss. Wien, vol. 12, p. 85, pl. 3, figs. 6, 7, 17.—PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 151, pl. 11, fig. 5.

Nodosaria reussi EGGER, 1899, Abh. d. II, Cl. d. k. Ak. d. Wiss. Bd. 21, Abth. 1, p. 57, pl. 6, fig. 35.

Test elongate, slender, tapering, arcuate, apical end rounded, apertural end slightly inflated; chambers numerous, eight in the type form, earlier chambers small, short, increasing in size very gradually, later ones elongate, slightly inflated, increasing in size as added, sutures straight; aperture slightly eccentric, terminal, radiate. Length of figured form, 1.5 mm.

DENTALINA ALTERNATA (Jones)
Plate 42, figure 6

Nodosaria zippei var. *alternata* JONES, 1884-1885, in Wright, Proc. Belfast Nat. Field Club, Appendix 9, pt. 4, p. 330, pl. 27, fig. 10.

Nodosaria alternata CARSEY, 1926, Univ. of Texas, Bull. 2612, p. 35, pl. 4, fig. 7.

Dentalina alternata PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 153, pl. 9, fig. 7.

Nodosaria affinis CUSHMAN, 1931, Jour. Pal., vol. 5, p. 305, pl. 35, fig. 2 (not 3-5).

Test straight, of uniform diameter, somewhat stout, apertural end rounded, apical end rather blunt, typically with a short, stout spine; chambers cylindrical, short, closely spaced, uninflated except last few, 8 to 10 in number; sutures flush in early stages, later slightly impressed; wall ornamented with sharp costae, extending the length of the test, with lower, less conspicuous costae between them; aperture terminal, protruding, round. Length of illustrated specimen, 1.8 mm.

The figures of this species given by Mrs. Carsey and Mrs. Plummer vary in details, Mrs. Carsey's specimen more closely resembling the original representation of the form in Wright's work. The figured specimen from the Ripley is very similar to the three previously published illustrations, and corresponds particularly well to the picture of the original type, which came from the Cretaceous of Ireland.

DENTALINA CRINITA Plummer
Plate 42, figure 5

Dentalina crinita PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 154, pl. 11, figs. 12, 13.

Test arcuate, elongate, slender, tapering, initial end rounded, apertural end drawn out into a short neck; chambers increasing in size as added, early ones short, of nearly uniform diameter, later ones longer, slightly inflated; surface covered with fine short spines adhering to walls of chambers, less prominent on later chambers; apertures at the end of neck, round. Length of illustrated specimen, 1.8 mm.

DENTALINA PINNIGERA Sandidge, n. sp.
Plate 42, figures 11, 12

Test slightly arcuate, of uniform diameter, somewhat stout, apertural end rounded with short projecting apertural neck, initial end blunt with a short stout spine; chambers closely spaced, eight in number, only slightly inflated in early stages, later chambers considerably inflated, last one nearly round; sutures very little impressed in early stages, distinctly constricted between last two or three

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chambers; wall ornamented by high fin-like costae extending from end to end of the test with lower, less conspicuous, often discontinuous costae lying between them, the number of each is six; aperture at the end of the protruding neck, round. Length of holotype, 1.4 mm.

This species bears characteristics of *Nodosaria raphanus* (Linnaeus) and of *N. intercostata* Reuss, but it differs from both these forms in being slightly yet consistently arcuate. In addition, the presence of the small intermediate costae removes it from the former, and the very prominent fin-like edges of the principal costae distinguish it from the later species. It also is closely related to *Dentalina alternata* (Jones),⁹ but differs from that species in being shorter and stouter, and in having the very wide transparent fins along the main costae. Numerous excellently preserved specimens of *D. pinnigera* occur throughout the upper part of the Ripley in Alabama.

The holotype is from an exposure at the mouth of Boguechitto Creek, on the Alabama River (Locality 106).

Genus NODOSARIA Lamarck

NODOSARIA RADICULA (Linnaeus)

Plate 42, figure 7

Nautilus radicula LINNAEUS, 1767, Syst. Nat., 12th Ed., p. 1164, No. 285.

Nodosaria radicula H. B. BRADY, 1884, Rep. Voy. Challenger, Zoology, vol. 9, p. 495, pl. 61, figs. 28-31.—FLINT, 1897 (1899), Ann. Rep. U. S. Nat. Mus., p. 309, pl. 55, fig. 1.—EGGER, 1902, Abh. d. II, Cl. d. k. Ak. Wiss. XXI, Bd. I, Abth. p. 67, pl. 5, fig. 40.—CUSHMAN, 1919, U. S. Nat. Mus., Bull. No. 100, vol. 4, p. 190, pl. 34,

fig. 4; 1913, U. S. Nat. Mus., Bull. No. 71, pt. 3, p. 52; 1923, U. S. Nat. Mus., Bull. No. 104, pt. 4, p. 73.—PLUMMER, 1926, Univ. Tex. Bull. 2644, p. 77, pl. 4, figs. 9a, b; 1931, Univ. Tex., Bull. 3101, p. 155, pl. 11, figs. 1, 2.—CHAPMAN, 1926, New Zealand Geol. Surv., Pal. Bull. No. 11, p. 52, p. 3, figs. 12, 14, 15, 19; pl. 11, fig. 9. *Nodosaria larva* CARSEY, 1926, Univ. Tex. Bull. 2612, p. 31, pl. 2, fig. 2.

Test elongate, slightly tapering, initial end rounded, apertural end larger, but drawn out slightly around the aperture; chambers few, compactly arranged; sutures flush and visible as thin lines in early stages, impressed between later chambers; wall smooth, polished; aperture terminal round. Length of illustrated specimen, 0.6 mm.

NODOSARIA ZIPPEI Reuss

Plate 42, figures 13, 14

Nodosaria zippei REUSS, 1845, Die Versteinerungen der böhemischen Kreid. formation, pt. 1, p. 25, pl. 8, figs. 1-3.—BEISSEL AND HOLZAPFEL, 1891, Abhandl. d. geol. Landesanstalt, n. Fol., Heft. 3, pp. 31, 32, pt. 6, figs. 10-29, pl. 16, fig. 32.—EGGER, 1899, Abh. d. II, Cl. d. k. Ak. d. Wiss., Bd. 21, Abth. 1, p. 78, pl. 8, fig. 3.

Nodosaria affinis CUSHMAN, 1931, Tenn. Geol. Surv. Bull. 41, p. 30, pl. 3, figs. 17-20; 1931, Jour. Pal., vol. 5, p. 305, pl. 35, figs. 3, 5.—1932, U. S. Nat. Mus., Proc., vol. 80, art. 14, p. 34, pl. 10, fig. 13.

Test elongate, apiculate, tapering at the apertural end to the protruding apertural neck, and at the initial end to a short spine; chambers few, usually inflated, in megalospheric form decreasing in size as added, increasing in size in microspheric form; sutures constricted in later stages, septae visible as dark bands between early chambers; wall ornamented with 10 strong, sharp costae extending from the apical spine to the aperture, giving the shell a fluted appearance, indented at the later sutures;

⁹ Plummer, Helen Jeanne, Texas, Univ., Bull. 3101, 1931, p. 153, pl. 11, fig. 7.

aperture central, radiate, protruding. Length of the illustrated specimens: microspheric form, 2.25 mm.; megaspheric, 1.3 mm.

Reference of this Ripley form to *Nodosaria zippei* is based primarily on the original description and figures of the species as given by Reuss.¹⁰

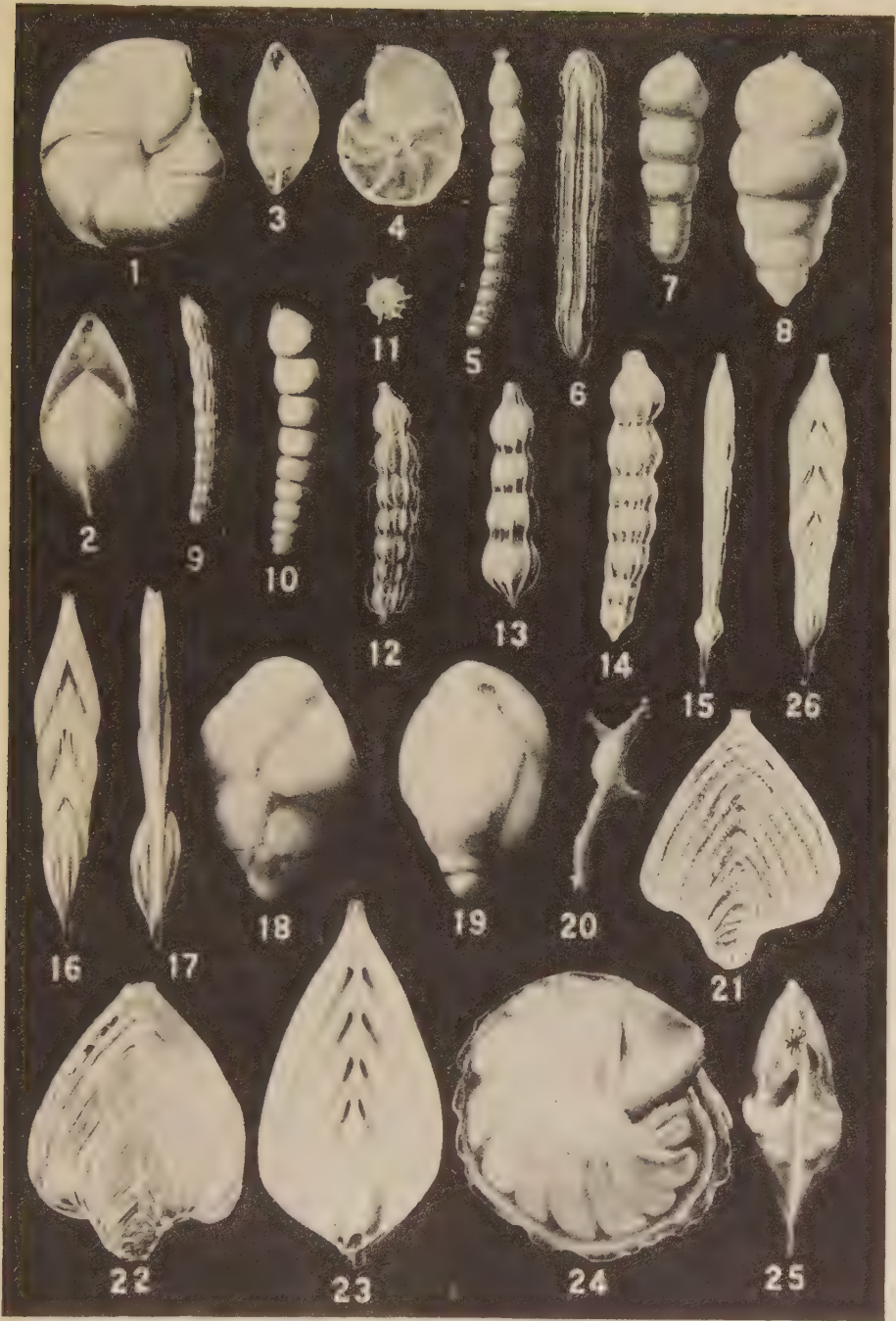
¹⁰ *Die Versteinerungen der böhmischen Kreide formation*, pt. 1, 1845, p. 25, pl. 8, figs. 1-3.

The description, freely translated, is as follows:

This important species, which sometimes reaches a length of 1.5 inches, is seldom preserved whole because of its fragility. It is straight, composed of 20-30 chambers, inflated in the upper part of the test, and separated by broad, deep constrictions. In the lower part of the test these constrictions are less distinct, and the early chambers are only slightly separated by a poorly developed

EXPLANATION OF PLATE 42

- FIGS. 1, 2—*Lenticulina jonesi* Sandidge, n. sp., $\times 38$. Holotype from Rocky Bluff, Locality 88. 1, Side view, showing slight inflation of chambers, and convexity of the apertural face. 2, Peripheral view, illustrating the character of the aperture.
- 3, 4—*Robulus aldrichi* Sandidge, n. sp., $\times 30$. Holotype from Red Bluff, Locality 105. 3, Apertural view, showing flatness of apertural face, and marginal rim. 4, Side view, illustrating shape and limbation of sutures.
- 5—*Dentalina crinita* Plummer, $\times 20$. Specimen from Rocky Bluff, Locality 88.
- 6—*Dentalina alternata* (Jones), $\times 23$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 7—*Nodosaria radicular* (Linnaeus), $\times 45$. Specimen from Rocky Bluff, Locality 88.
- 8—*Nodosaria manifesta* (Reuss), $\times 28$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 9—*Dentalina confluent* Reuss, $\times 25$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 10—*Dentalina reussi* Neugeboren, $\times 22$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 11, 12—*Dentalina pinnigera* Sandidge, n. sp., $\times 23$. Holotype from exposure at the mouth of Boguechitto Creek, Locality 106. 11, Cross-sectional view at the top of the last chamber, showing aperture and arrangement of the costae. 12, View showing the transparent, fin-like costae, and general appearance of test.
- 13, 14—*Nodosaria zippei* Reuss, 13, Megaspheric form, from exposure at the mouth of Boguechitto Creek, Locality 106, $\times 23$. 14, Microspheric form, from Barton's Bluff, Locality 53, $\times 12$.
- 15, 26—*Fronidularia archiaciana* d'Orbigny, $\times 22$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 15, Edge view, showing truncate character of margin. 26, Side view, showing flat face and sutures.
- 16, 17—*Fronidularia cuspidata* Cushman, $\times 40$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 16, Side view, showing large, fluted proloculum. 17, Edge view, illustrating inflation of proloculum, and compression of test in later stages.
- 18, 19—*Buliminella cushmani* Sandidge, n. sp. $\times 80$. Holotype from exposure at the mouth of Boguechitto Creek, Locality 106. 18, View of side opposite the aperture, showing spiral sutures. 19, View showing the aperture, gracefully curving sutures, and the smoothness of the test.
- 20—*Ramulina globulifera* H. B. Brady, $\times 22$. Specimen from Prairie Bluff, Locality 87.
- 21—*Flabellina interpunctata* Von der Marck, $\times 18$. Specimen from Rocky Bluff, Locality 88.
- 22—*Flabellina rugosa* d'Orbigny, $\times 18$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
- 23—*Fronidularia trispiculata* Sandidge, n. sp., $\times 38$. Holotype from exposure at the mouth of Boguechitto Creek, Locality 106. The three spines may be seen at the lower extremity of the proloculum.
- 24, 25—*Lenticulina iota* (Cushman), $\times 16$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 24, Side view, showing keel. 25, Peripheral view, illustrating the aperture.



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groove. The proloculum is globular, usually somewhat larger than the next adjacent chamber, and has a short spine. Running longitudinally on the chambers there are from 7 to 14 strong, raised, fin-like costae, the number of which is variable on a single individual. Often the number of costae is increased by the insertion of new ones, that is, some of the costae begin and end suddenly. Very rarely two neighboring costae may fuse. Often between two costae one or two long, raised lines, suggesting additional costae, may be seen. The last chamber ends in an elongation on which is found the small, round aperture. The interior of each chamber is entirely round, and communicates with adjacent chambers by a short, cylindrical canal.

Ten years after this description appeared, Reuss,¹¹ in his discussion of *N. polygona*, indicates that the two forms are similar but that *N. zippei* is distinguished by having a larger number (7-14) of ribs. *N. polygona* has eight ribs. *N. zippei* thus clearly is a form with many costae.

The Ripley specimens, it is true, are much smaller than Reuss's largest representatives, but in all essential structural details they closely resemble the original type. Beissel has figured and described a series of specimens of this species ranging from a juvenile, single-chambered form to an adult with 20 chambers. The Ripley specimens duplicate practically all the stages Beissel has represented.

This form closely resembles many specimens from the Cretaceous which have been referred to *Nodosaria affinis*, but it is very difficult to reconcile the published figures and descriptions of these representatives with the original description and

figures of this species as given by Reuss.¹² A free translation of this description is as follows:

Test 2.5-3 mm. long, very thin, straight, slightly tapering to initial end; from 8 to 9 small, elliptical chambers, separated by distinct constrictions, ornamented with from 4 to 5 high, fin-like, irregular costae, which are reduced at the constrictions. The proloculum is drawn out sharply to a short, hair-like spine. The last chamber is moderately pointed.

Later Reuss¹³ points out that *Dentalina baltica* is very similar to *D. (Nodosaria) affinis*, but that the latter is distinguished by the spine on the first chamber and the smaller number of longitudinal costae. *D. baltica* has from 8 to 9 ribs or costae; so it is clear that in Reuss's mind, *D. (N.) affinis* was a form possessing very few ribs.

The figured specimens of *N. affinis* from the Coastal Plain in this country possess many more than four or five costae, and these, while they may be somewhat indented where the chambers join, continue across the constrictions. These specimens also have chambers which, as added, vary in size much more than do those of *N. affinis* Reuss. Some confusion undoubtedly has arisen because many forms have been referred to the pre-occupied *N. affinis* of d'Orbigny,¹⁴ while it appears that some of the American specimens which have been called *Nodosaria affinis* may be referred to the closely related *N. verte-*

¹² *Die Versteinerungen der böhmischen Kreide formation*, pt. 1, 1845, p. 26, pl. 13, fig. 16.

¹³ *Zeit. Deut. geol. Ges.*, Bd. 7, 1855, p. 269.

¹⁴ *Foram. Foss. Vienne*, 1846, p. 39, pl. 1, figs. 36-39.

¹¹ *Zeit. Deut. geol. Ges.*, Bd. 7, 1855, p. 266.

bralis Batsch,¹⁵ the majority of these forms belong to *N. zippei* Reuss.

NODOSARIA MANIFESTA (Reuss)

Plate 42, figure 8

Glandulina manifesta REUSS, 1851, Hardinger's Naturw., Abh., Bd. 4, Abth. 1, pl. 2, fig. 4.—EGGER, 1899, Abh. kön. bay. Akad. Wiss. München Cl. II, vol. 21, Bd. 1, p. 82, pl. 5, figs. 27, 28.

Nodosaria (Glandulina) manifesta, CUSHMAN, 1926, Bull. Am. Assn. Petroleum Geol., vol. 10, p. 595, pl. 18, fig. 8.

Test elongate, somewhat stout, conical, apertural end rounded, initial end bluntly pointed; chambers inflated, diameter about twice the height, early ones small, increasing in size as added, sutures distinct, constricted between later chambers; wall rather thick, smooth, sometimes retaining the original polish; aperture terminal, central, radiate. Length of illustrated specimen, 0.6 mm.

Genus FRONDICULARIA DeFrance

FRONDICULARIA ARCHIACIANA d'Orbigny

Plate 42, figures 15, 26

Frondicularia archiaciana D'ORBIGNY, 1840, Mém. Soc. Géol. France, vol. 4, p. 20, pl. 1, figs. 34–36.—REUSS, 1845, Verst. böhm. Kreidef., pt. 1, p. 31, pl. 13, fig. 29.—CHAPMAN, 1894, Jour. Roy. Mic. Soc., p. 154, pl. 3, fig. 6.—EGGER, 1899, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 21, Bd. 1, p. 87, pl. 10, fig. 19.—CUSHMAN, 1930, Contr. Cush. Lab. Foram. Res., vol. 6, pt. 2, p. 37, pl. 5, figs. 9–12; 1931, Tenn. Geol. Surv., Bull. 41, p. 35, pl. 4, figs. 13a, b.

Test elongate, evenly compressed, slightly wider near the apertural end than at the initial end, rectangular in transverse section, sides cut squarely; chambers few from 6 to 8 in number, large, initial one spherical, bearing

an apical spine and three or four distinct longitudinal costae, later chambers chevron-shaped, increasing in size as added, last one drawn out into a neck bearing the aperture; sutures distinct, raised into narrow ridges, forming inverted V's; wall smooth except in early stages when the surface is marked by a few discontinuous, longitudinal striations; aperture terminal, produced, round, radiate. Length of illustrated specimen, 2.1 mm.

FRONDICULARIA CUSPIDATA Cushman

Plate 42, figures 16, 17

Frondicularia cuspidata CUSHMAN, 1931, Tenn. Geol. Surv., Bull. 41, p. 36, pl. 5, figs. 4, 5.

Test elongate, slender, widest at the base of the last-formed chamber, tapering gracefully to a long, pointed spine on the base of the proloculum an elongate, fusiform chamber, with five equally spaced, longitudinal striae visible on each face; later chambers flat, of elongate-chevron shape, edges truncate with sharp angles; sutures slightly raised, open at the top, ornamented with exceedingly fine, longitudinal striae; aperture at the apex of the last chamber. Length of the illustrated specimen, 1.2 mm.

FRONDICULARIA TRISPICULATA Sandidge, n. sp.

Plate 42, figure 23

Test flat, sagitate, elongate, widest across the face at the level of the aperture of the proloculum, sides curving, sloping gradually to the aperture of the last chamber, and abruptly to the base of the prolocu-

¹⁵ *Conch. des Seesandes*, 1791, p. 3, No. 6, pl. 2, fig. 6.

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lum; proloculum pear-shaped, bearing two closely spaced costae on each face which extend from its aperture to the base where they fuse to form a small, short spine on either side; a single strong spine extends downward from the bottom of the test between the small spines; later chambers are chevron-shaped, gracefully curving from aperture to the lower ends, tapering downward, sides truncate; sutures slightly elevated, rounded, open at the top; apertures of early chambers visible between upper ends of sutures, final aperture slightly radiate, small, round, protruding. Length of the holotype, 1.3 mm.

This new species resembles in its general characteristics *F. goldfussi* Reuss, but is easily distinguished by the sharply truncate margin, the pattern of the sutures, and the presence of the three spines at the base of the test. There is some similarity to *F. alata* d'Orbigny, and to *F. gaultina* Reuss, although the new species is very distinctive in its detailed structure.

F. trispiculata occurs rarely in the lower Ripley in the western and central parts of Alabama. The holotype is from exposures at the mouth of Boguechitto Creek, on Alabama River (Locality 106).

Genus FLABELLINA d'Orbigny

FLABELLINA RUGOSA d'Orbigny

Plate 42, figure 22

Flabellina rugosa D'ORBIGNY, 1840, Mém. Soc. Géol. France, ser. 3, vol. 4, pt. 1, p. 23, pl. 2, figs. 4, 5, 7.—REUSS, 1845-46, Verstein. bohm. Kreidef. p. 33, pl. 8, figs. 31-35, pl. 13, figs. 49-53.—PLUMMER, 1931, Univ. Tex., Bull. 3101, p. 166, pl. 12, fig. 4.—CUSHMAN, 1931, Jour. Pal., vol. 5, p. 307, pl. 35, fig. 10.

Fronidicularia rugosa PLUMMER, 1926, Univ. Tex., Bull. 2644, p. 118, pl. 5, fig. 1; text fig. 13.

Test rhomboidal in shape, compressed, margins truncate, extremities drawn out, the initial end somewhat obtuse; chambers numerous, narrow, chevron-shaped; sutures raised, earlier ones forming semicircles at the crest of each chamber; aperture terminal, round, small. Length of illustrated specimen, 2.1 mm.

FLABELLINA INTERPUNCTATA Von der Marck
Plate 42, figure 21

Flabellina interpunctata VON DER MARCK, 1858, Verh. nat. Ver. preuss. Rheinl., vol. 15, p. 53, pl. 1, fig. 5.—REUSS, 1860, Sitz. Akad. Wiss. Wien, vol. 40, p. 216, pl. 9, fig. 1.—WHITE, 1928, Jour. Pal., vol. 2, p. 204, pl. 29, fig. 1.—CUSHMAN, 1930, Contr. Cush. Lab. Foram. Res., vol. 6, pt. 2, p. 30, pl. 4, figs. 16, 17; 1931, Jour. Pal., vol. 5, p. 307, pl. 35, fig. 9.—PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 163, pl. 12, figs. 1-3.

Flabellina rugosa BEISSSEL, 1891, Abhandl. Kön. Preuss. geol. Landes., N. Fol., vol. 3, p. 47, pl. 9, figs. 20-24.

Test flat, compressed, generally rhomboid in outline, periphery truncate; chambers coiled in early stages, later ones extending down on either side in the plane of coiling; sutures raised, sharp, often with loop-like structures at the tops of the chambers; wall between the sutures ornamented with numerous small papillae; aperture at the end of a short projection on the last chamber. Length of illustrated specimen, 1.6 mm.

Family POLYMORPHINIDAE

Genus RAMULINA Rupert Jones

RAMULINA GLOBULIFERA H. B. Brady

Plate 42, figure 20

Ramulina globulifera H. B. BRADY, 1884, Rep. Voy. Challenger, Zoology, vol. 9, p. 587,

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pl. 76, figs. 22-28.—CUSHMAN, 1927, Contr. Cush. Lab., vol. 3, pt. 1, p. 48, pl. 9, fig. 19.—PLUMMER, 1931, Univ. Tex., Bull. 3101, p. 174, pl. 10, fig. 15.

Test free, branching, composed of a subglobular chamber with a connecting stoloniferous tube and several radiating tubules; wall hyaline, surface marked by sparsely set spines; apertures tubular. Length of illustrated specimen, 1.2 mm.

Family BULIMINIDAE

Genus BULIMINELLA Cushman

BULIMINELLA CUSHMANI Sandidge, n. sp.

Plate 42, figures 18, 19

Test small, compactly fusiform, spirally coiled, involute, circular in transverse section, the initial end pointed, apertural end tapering more gradually and rounded at the top; chambers numerous, four in the last whorl, slightly inflated; sutures impressed; wall smooth, finely perforate, thin; aperture a comma-like opening at the end of the last chamber, extending from near the apex down to the last whorl. Length of holotype, 0.4 mm.

This species is very similar to *Buliminella carseyae*,¹⁶ but differs from it in being smaller and more compact. Also the chambers are less inflated, and the sutures curve more gracefully than in *B. carseyae*.

The holotype of the species came from the exposure at the mouth of Boguechitto Creek (Locality 106).

This species is named for Dr. Joseph A. Cushman, Sharon, Massachusetts.

¹⁶ Plummer, Helen Jeanne, *Texas. Univ. Bull.* 3101, 1931, p. 179, pl. 8, fig. 9.

Genus BULIMINA d'Orbigny

BULIMINA PUPOIDES d'Orbigny

Plate 43, figure 1

Bulimina pupoides D'ORBIGNY, 1846, Foram. Foss. Vienne, p. 185, pl. 11, figs. 11, 12.—H. B. BRADY, 1884, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 400, pl. 50, figs. 15a, b.—EGGER, 1902 (1899). Abh. d. II, Cl. d. k. Ak. d. Wiss. XXI, Bd. I, abth.,—CUSHMAN, 1911, U. S. Nat. Mus., Bull. No. 71, p. 80, fig. 132.—PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 180, pl. 9, fig. 15.

Test oval in shape, somewhat pointed at apical end, rounded at the apertural end, slightly tapering; chambers numerous, early ones small, the last few increasing rapidly in size, inflated, all arranged triserially; sutures indistinct in early portion of test, slightly depressed and easily visible between later chambers; wall smooth, thin, perforate, aperture a narrow slit extending obliquely downward from apex of last chamber. Length of illustrated specimen, 0.4 mm.

BULIMINA SUBORNATA Brady

Plate 43, figure 2

Bulimina subornata BRADY, 1884, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 402, pl. II, figs. 6a, b.—CUSHMAN, 1911, U. S. Nat. Mus., Bull. No. 71, p. 88, fig. 141.

Test oval in shape, tapering slightly from the apertural end to the initial end, pointed at the initial end, which bears a short spine, rounded at the apertural end; chambers numerous, arranged triserially, increasing in size as added, last few somewhat inflated; early chambers ornamented with fine, raised longitudinal costae; wall thin, perforate; aperture a narrow slit extending downward obliquely from the apex of the last chamber.

FORAMINIFERA FROM RIPLEY FORMATION

Length of the illustrated specimen,
0.4 mm.

BULIMINA ELONGATA d'Orbigny Plate 43, figure 3

Bulimina elongata D'ORBIGNY, 1846, For. Foss. Vienne, p. 187, pl. 21, figs. 19, 20.—H. B. BRADY, 1884, Rep. Voy. Challenger, Zoology, vol. 9, p. 401, pl. 51, figs. 1, 2.—CUSHMAN, 1911, U. S. Nat. Mus., Bull. No. 71, p. 79, fig. 131.

Test elongate, nearly cylindrical, slightly pointed at apical end, rounded at oval end; chambers numerous, increasing in size very gradually from initial portion, inflated, short; sutures distinct, depressed; wall smooth, very finely punctate, thin, aperture a vertical elongate opening at inner edge of last chamber. Length of illustrated specimen, 0.45 mm.

Genus BOLIVINA d'Orbigny BOLIVINA INCRASSATA Reuss Plate 41, figure 21

Bolivina incrassata REUSS, 1851, Hardinger's Nat. Abh., vol. 4, p. 29, pl. 4, fig. 13; 1861, (1862), Sitz. Akad. Wiss. Wien. vol. 44, pt. 1, p. 332.—CUSHMAN, 1926, Contr. Cush. Lab., vol. 2, p. 19, pl. 2, figs. 1a, b; Idem. p. 86, pl. 12, figs. 1a, b; 1927, Jour. Pal., vol. 1, p. 161, pl. 28, fig. 11; 1931, Tenn. Geol. Surv., Bull. 41, p. 49, pl. 8, figs. 2-4; 1931, Jour. Pal., vol. 5, p. 310, pl. 35, figs. 17a, b.

Test stout, laterally compressed, slightly tapering, widest at apertural end, proloculum inflated in megalospheric form, pointed in microspheric form; chambers numerous, low, slightly inflated; sutures impressed, oblique, distinct; wall smooth, finely punctate; aperture elongate, extending downward along shorter edge of last chamber from the apex to its base. Length of illustrated specimen, 0.9 mm.

Family ROTALIIDAE

Genus DISCORBIS Lamarck DISCORBIS CORRECTA Carsey Plate 43, figures 7-9

Discorbis correcta CARSEY, 1926, Univ. of Texas, Bull. 2612, p. 45, pl. 3, figs. 5a, b.—PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 188, pl. 14, figs. 1-4.

Test generally oval in outline, dorsal face somewhat convex, ventral face slightly concave, umbilicate; peripheral margin thin but rounded; chambers curving, increasing in size rather rapidly, usually 8 in last whorl, surface distinctly punctate; sutures on both sides curved, flush with surface in early stages, sharply impressed between later chambers; aperture a well defined slit extending from the ventral margin under an apertural lip into the small excavated umbilical depression. Diameter of illustrated specimen, 0.3 mm.

Genus VALVULINERIA Cushman VALVULINERIA RIPLEYENSIS Sandidge, n. sp. Plate 43, figures 4-6.

Test oval, biconvex, somewhat flattened on the dorsal side, ventral side strongly convex, periphery broadly rounded, umbilical cavity deep; chambers numerous, all visible dorsally, 7 to 8 in the last whorl, increasing in size rapidly, last few inflated, with a V-shaped flap extending into the umbilical cavity; sutures distinct, later ones deeply impressed; wall smooth, coarsely punctate; aperture an elongate opening extending from the periphery into the umbilical area, partially covered by the umbilical flap of the last chamber. Diameter of the holotype, 0.6 mm.

The holotype is from Ripley exposures at the mouth of Boguechitto Creek (Locality 106).

Genus GYROIDINA d'Orbigny

GYROIDINA SOLDANII D'ORBIGNY

Plate 43, figures 10-12

Gyroidina soldanii D'ORBIGNY, 1826, Ann. Sci. Nat., vol. 7, p. 278, No. 5.

Rotalia soldanii BRADY, 1884, Rep. Voy. Challenger, Zoology, vol. 9, p. 706, pl. 107, figs. 6, 7.—EGGER, 1893, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, p. 420, pl. 19, figs. 16-18, 51; 1899, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 21, p. 156, pl. 20, figs. 26, 27, 28.—CUSHMAN, 1915, U. S. Nat. Mus., Bull. No. 71, pt. 5, p. 71, pl. 29, fig. 1; 1921, pl. 31, fig. 4; U. S. Nat. Mus., Bull. No. 100, vol. 4, p. 349, pl. 71, figs. 2a-c.—CHAPMAN, 1926, New Zealand Geol. Surv., Pal. Bull. No. 11, p. 86, pl. 5, figs. 23a-c, 24a-c.

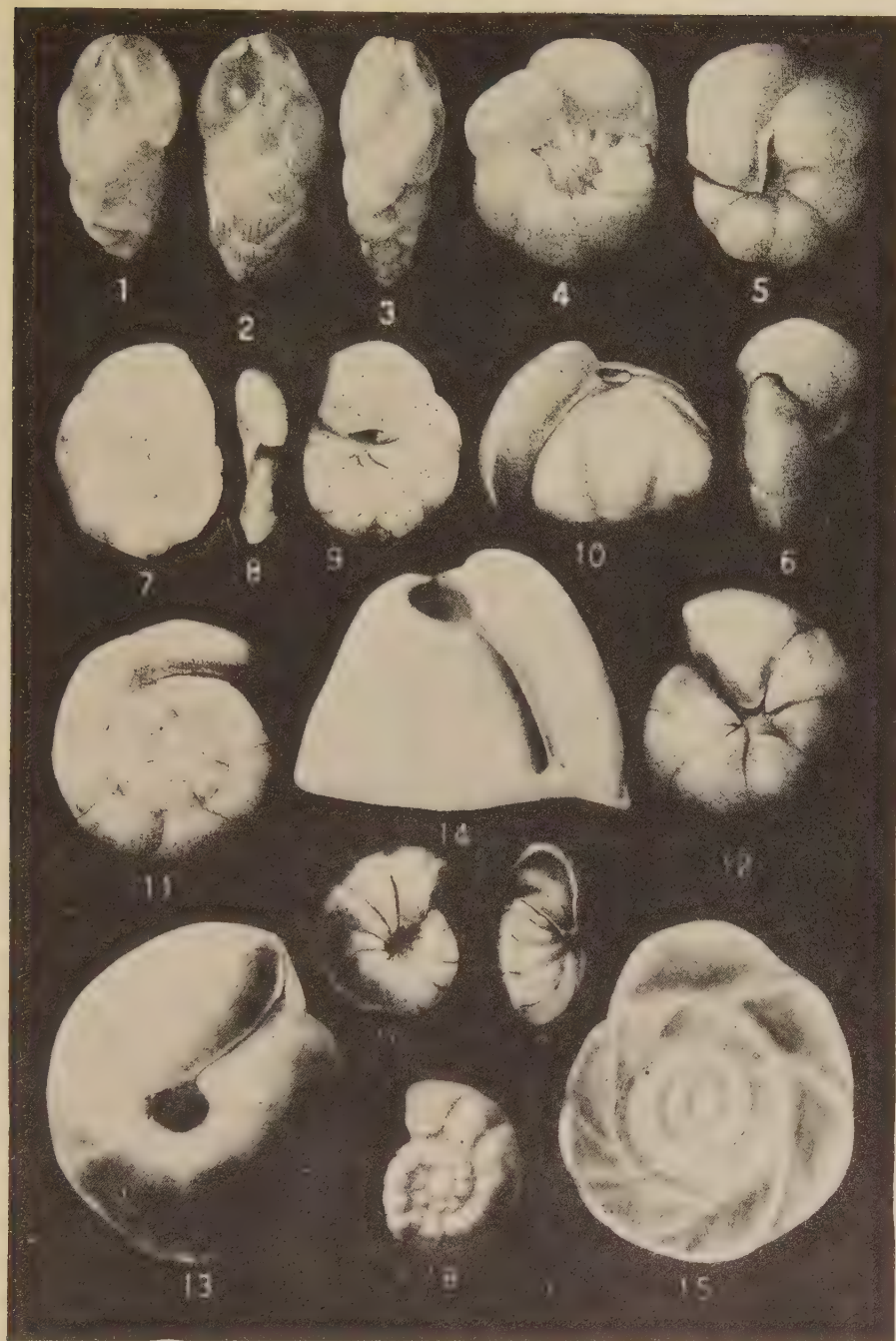
Test plano-convex, dorsal side flat or slightly convex with a spiral depression marking the boundary of each whorl, ventral side strongly con-

vex, a small umbilical cavity at the center; chambers numerous, distinct, narrow, elongate, curving in the axial plane; sutures on ventral side smooth or only slightly impressed, distinctly impressed on the dorsal side, especially around the periphery; wall smooth, thick, finely perforate; aperture a narrow, elongate slit extending from near the periphery almost to the umbilicus along the margin of the last-formed chamber. Diameter of illustrated specimen, 0.35 mm.

The representatives of *G. soldanii* found in the Ripley formation, though not so acutely angular at the periphery as d'Orbigny's models indicate his specimens were, nevertheless correspond very closely to the figures of Brady, Egger, Chapman, and Cushman.

EXPLANATION OF PLATE 43

- FIGS. 1—*Bulimina pupoides* d'Orbigny, $\times 75$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
2—*Bulimina subornata* Brady, $\times 85$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106.
3—*Bulimina elongata* d'Orbigny, $\times 75$. Specimen from Red Bluff, Locality 105.
4, 5, 6—*Valvulineria ripleyensis* Sandidge, n. sp., $\times 50$. Holotype from exposure at the mouth of Boguechitto Creek, Locality 106. 4, Dorsal view, showing early coils. 5, Ventral side, illustrating prominent flap extending over umbilical area. 6, Peripheral view, showing position and character of the aperture.
7, 8, 9—*Discorbis correcta* Carsey, $\times 90$. Three specimens from exposure at the mouth of Boguechitto Creek, Locality 106. 7, Dorsal view, showing evolute coiling. 8, Peripheral aspect. 9, Ventral side, illustrating aperture at the edge of last chamber.
10, 11, 12—*Gyroidina soldanii* d'Orbigny, $\times 90$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 10, Peripheral view, showing convexity of test and apertural face, with aperture extending from near the base to the umbilicus. 11, Dorsal face, showing evolute coiling. 12, Ventral aspect, illustrating umbilicus.
13, 14, 15—*Gyroidina alabamensis* Sandidge, n. sp., $\times 130$. Holotype from exposure at the mouth of Boguechitto Creek, Locality 106. 13, Ventral view, showing the prominent umbilical cavity. 14, Peripheral view, giving generally conical appearance of test and showing the character of the aperture. 15, Dorsal face, illustrating evolute coiling and oblique angle of transverse sutures.
16, 17, 18—*Gyroidina depressa* (Alth.), $\times 80$. Specimen from Red Bluff, Locality 105. 16, Ventral view, showing smoothness and transparency of test. 17, Peripheral view, showing compression of test and character of aperture. 18, Dorsal view, showing evolute coiling and type of sutures.



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GYROIDINA DEPRESSA (Alth)

Plate 43, figures 16-18.

Rotalina depressa ALTH, 1850, Haidingen's Nat. Abhand. vol. 3, p. 226, pl. 13, fig. 21.

Rotalia cretacea CARSEY, 1926, Univ. Texas Bull. 2612, p. 48, pl. 5, figs. 7a, b.

Gyroidina depressa CUSHMAN AND CHURCH, 1929, Proc. Calif. Acad. Sci., Ser. 4, vol. 18, p. 515, pl. 41, figs. 4-6; PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 190, pl. 13, fig. 3; CUSHMAN, 1931, Tenn. Geol. Surv., Bull. 41, p. 54, pl. 9, figs. 7, 8; 1931, Jour. Pal., vol. 5, p. 311, pl. 36, figs. 2a-c.

Test round, biconvex, dorsal side low, ventral face more highly convex, periphery rounded, lobate in the later stages; chambers numerous, 11 or 12 in the last whorl, later ones slightly inflated; sutures on dorsal side short and gently curved, impressed between later chambers, on ventral side slightly curved and radiating from the center; umbilicus small, sometimes occupied by a node of shell material; wall smooth, finely punctate; aperture a narrow, elongate slit at the base of the last chamber and extending from the periphery to the umbilicus. Diameter of illustrated specimen, 0.35 mm.

GYROIDINA ALABAMENSIS Sandidge, n. sp.

Plate 43, figures 13-15

Test plano-convex, dorsal side flat, ventral side strongly convex, conical, a small umbilical cavity at the apex, periphery sharply angular, not keeled; chambers numerous, seven in the last whorl, narrow, elongate, spirally coiled; sutures on ventral side flush, curving from umbilical cavity to periphery, on dorsal side slightly impressed, tangent to the penultimate coil, extending obliquely to the periphery; wall smooth, very finely perforate; aperture a nar-

row elongate slit extending along the inner edge of the face of the last chamber from near the margin into the umbilical cavity. Diameter of the holotype, 0.45 mm.; height, 0.35 mm.

This species closely resembles *Eponides micheliniana* (d'Orbigny) as figured and described by Mrs. Plummer,¹⁷ and *Globorotalia micheliniana* (d'Orbigny) as shown by Cushman.¹⁸ Neither of these forms corresponds exactly to d'Orbigny's original figures of *Rotalina micheliniana*, which has a highly convex ventral side and acute apex with no suggestion of an umbilical cavity. Since d'Orbigny's type specimen is reported to have been lost, the validity of *Eponides micheliniana* and of *Globorotalia micheliniana* both may be questioned. Whether or not these forms belong in the synonymy with *Gyroidina alabamensis* n. sp. cannot be determined until close comparisons of the specimens have been made. The evidence for placing the Ripley species in the genus *Gyroidina* is based largely on its close resemblance to d'Orbigny's models and figures of specimens assigned to this genus, particularly his representation of *Gyroidina soldanii*, which is strongly convex ventrally and has a well defined umbilical opening. This form in its general characteristics also bears a marked resemblance to *Gyroidina girardana* (Reuss), which has an angular periphery. The fact that the aperture extends as a long

¹⁷ Plummer, Helen Jeanne, *Texas Univ. Bull.* 3101, p. 192, pl. 14, fig. 11, 1931.

¹⁸ Cushman, J. A., *Contr. Cushman Lab. Foram. Research*, vol. 7, pt. 2, p. 45, pl. 6, figs. 8a-c, 1931.

slit from near the periphery into the umbilical cavity removes the new species from *Eponides*. The very finely punctate, highly polished test easily distinguishes it from *Globorotalia* with its characteristically rough, cancellated shell. Other diagnostic features of the latter genus, such as globigerine characteristics and early chambers like *Globigerina*, also are lacking in *Gyroidina alabamensis*. The species occurs abundantly in the Ripley formation and holds promise of being a very useful guide fossil.

The holotype is from exposures at the mouth of Boguechitto Creek, on Alabama River (Locality 106).

Family CHILOSTOMELLIDAE

Genus PULLENIA Parker and Jones

PULLENIA QUATERNARIA (Reuss)

Plate 44, figures 16, 17

Nonionina quaternaria REUSS, 1851, Haidinger's Nat. Abh., vol. 4, pt. I, p. 34, pl. 2, fig. 13.

Pullenia quaternaria CUSHMAN, 1931, Tenn. Geol. Surv., Bull. 41, p. 57, pl. 10, figs. 5a, b; 1931, Jour. Pal., vol. 5, p. 313, pl. 36, figs. 4a, b.

Test nearly spherical, coiled, bilaterally symmetrical; chambers numerous, forming several convolutions, five in each whorl, completely embracing so that only the last coil is visible, gradually increasing in size as added; sutures in early stages appearing as narrow, dark lines, very slightly impressed between last two chambers; wall finely punctate, surface smooth; aperture a narrow, slightly arched slit extending across the periphery at the base of the last-formed chamber. Diameter of the illustrated specimen, 0.28 mm.

Family GLOBIGERINIDAE

Genus GLOBIGERINELLA Cushman

GLOBIGERINELLA VOLUTA (White)

Plate 44, figures 1, 2

Globigerina aequilateralis CHAPMAN, 1896, Jour. Roy. Micro. Soc., p. 589, pl. 13, fig. 7.—EGGER, 1899, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 21, p. 169, pl. 21, figs. 9, 11.

Globigerina voluta WHITE, 1928, Jour. Pal., vol. 2, p. 197, pl. 28, fig. 5.

Test plano-spiral, loosely coiled, bilaterally symmetrical, consisting of about one and a half volutions; chambers numerous, inflated, globular, increasing in size as added; sutures deeply impressed; wall reticulate, bearing numerous fine spines; aperture a large arched opening at the base of the last chamber. Diameter of illustrated specimen, 0.3 mm.

Family GLOBOROTALIIDAE

Genus GLOBOTRUNCANA Cushman

GLOBOTRUNCANA CANALICULATA (Reuss)

Plate 44, figures 3–5

Rosalina canaliculata REUSS, 1854, Denkschr. D. K. Akad. Wiss. Wien vol. 7, p. 70, pl. 26, figs. 4a, b.

Globigerina linnaeana PARKER, JONES, AND BRADY, 1895, Foram. of the Crag. pt. II, p. 285, pl. 7, figs. 23a, b.

Globigerina canaliculata EGGER, 1899, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 21, p. 172, pl. 21, figs. 15–17, 24–26.

Globotruncana canaliculata CUSHMAN, 1927, Contr. Cush. Lab. Foram. Res., vol. 3, pt. 2, p. 116, pl. 23, figs. 11a, b, c.

Test trochoid, dorsal side flat, ventral side convex, excavated at the umbilicus, periphery truncate, flat, a keel at each edge, scalloped; chambers in early stages very small and slightly inflated, later flattened dorsally, lobate ventrally, flattened at the sides bearing a double row of very

FORAMINIFERA FROM RIPLEY FORMATION

fine beads which form keels at the angles; sutures raised, formed by the keeled edges of the chambers; wall punctate and very finely spinose; aperture ventral, opening into the umbilical cavity. Diameter of illustrated specimen, 0.45 mm.

GLOBOTRUNCANA ARCA (Cushman)

Plate 44, figures 6-8

Pulvinulina arca CUSHMAN, 1926, Contr. Cush. Lab. Foram. Res., vol. 2, pt. 1, p. 23, pl. 3, figs. 1a-c.

Globotruncana arca CUSHMAN, 1927, Contr. Cush. Lab. Foram. Res., vol. 3, pt. 1, p. 91, pl. 19, fig. 11; 1931, Tenn. Geol. Surv., Bull. 41, p. 59, pl. 11, figs. 6a-c.—PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 195, pl. 13, figs. 7-9.

Test round, equally biconvex in early stages, later becoming more convex ventrally, umbilicate, composed of numerous closely coiled chambers, all chambers visible on dorsal side, only those of the last whorl on ventral side, periphery truncate, bordered by a double keel in early stages, later becoming single, sutures distinct, on the dorsal side limbate, ornamented with small beads, curving from the periphery toward center of the coil, outer edges forming the dorsal keel of the test, on the ventral side depressed, curving in hook-like fashion toward center, joining umbilicus; aperture on ventral side at the base of the last-formed chamber, opening into the umbilicus. Diameter of illustrated specimen, 0.5 mm.

GLOBOTRUNCANA FORNICATA Plummer

Plate 44, figures 12, 13

Globotruncana fornicata PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 198, pl. 13, figs. 4-6.

Test generally circular in outline, margin scalloped, truncate, bordered by a double keel, biconvex, all chambers visible on dorsal side, only last whorl visible ventrally, umbilicate on ventral side; chambers numerous, four or five in last whorl, crescent shaped in later stages, rather flat on dorsal side with a slight crenulation extending across widest part, somewhat inflated ventrally, ends overlapping; sutures curving gracefully from margin toward center of test, limbate on dorsal side, ornamented with very small beads or spines, smooth and impressed ventrally; surface of test covered with very small papillae or fine spines; aperture at the base of the chambers on ventral side, opening into umbilicus, a short flap sometimes present. Diameter of illustrated specimen, 0.4 mm.

GLOBOTRUNCANA CONVEXA Sandidge, n. sp.

Plate 44, figures 9-11

Test trochoid, umbilicate, highly convex dorsally, convexity less pronounced on ventral side, periphery lobate, keeled, sides only slightly truncate, a poorly developed secondary keel at the ventral margin; chambers in very early stages globigerine, closely coiled, increasing in size as added, later ones petalloid and smooth on dorsal side, outer margin carinate, acutely lobate on ventral side, forming a sharp ridge around the umbilicus; sutures slightly limbate dorsally, limbation formed by carinate margins of chambers, impressed ventrally; wall finely papillose; aperture opening into the um-

bilical area; umbilical cavity large. Diameter of the holotype, 0.32 mm.

This species resembles very old specimens of *Globotruncana arca*, but it may be distinguished from them by its more pronounced dorsal convexity, and the distinctly petalloid appearance of the later chambers. The last few chambers frequently bear a slight transverse depression near the middle.

The holotype is from Red Bluff, on Alabama River (Locality 105).

ANOMALINA TAYLORENSIS Carsey

Plate 44, figures 14, 15

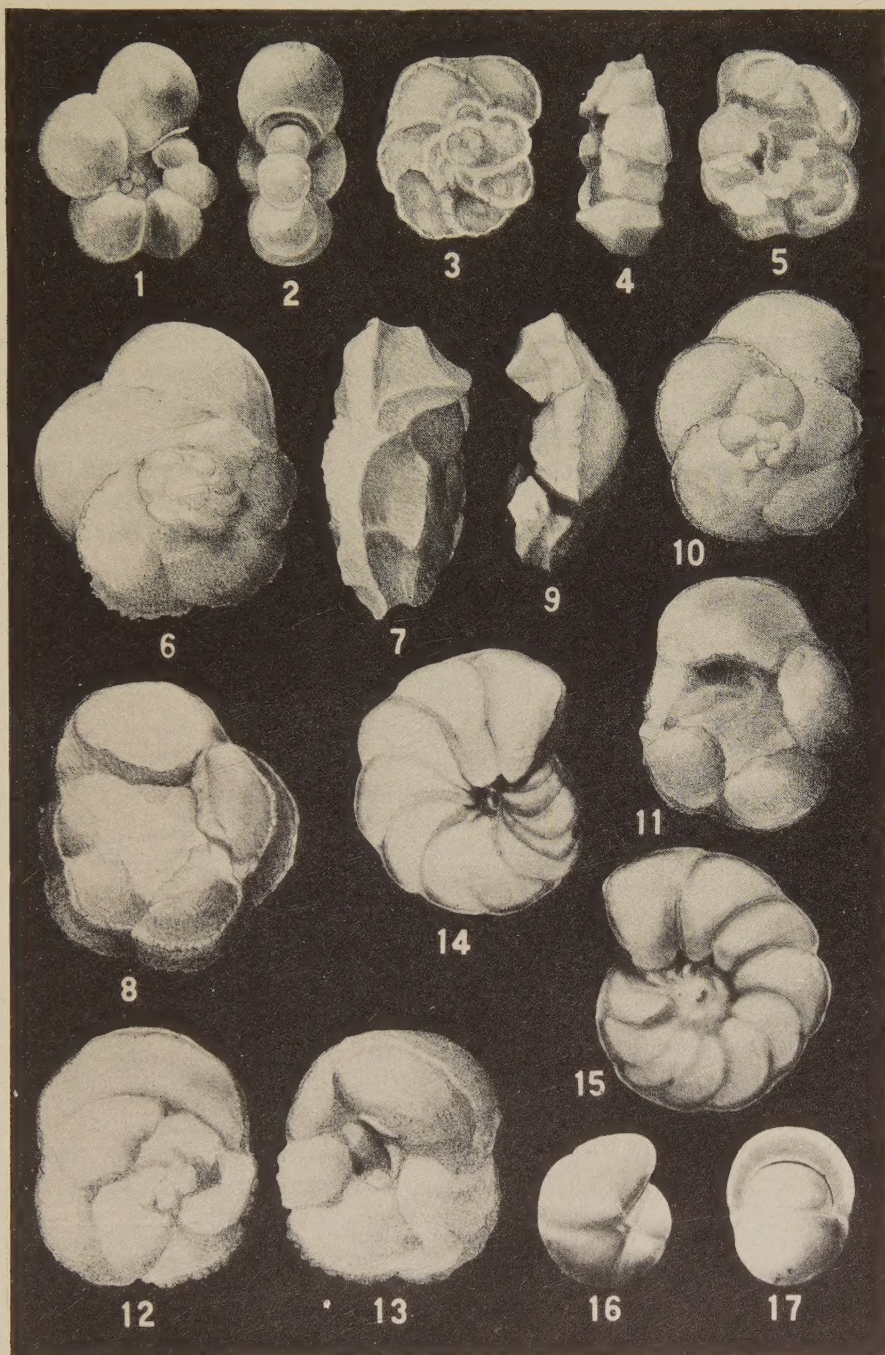
Anomalina taylorensis CARSEY, 1926, Univ. of Texas, Bull. 2612, p. 47, pl. 6, figs. 1a, b.—PLUMMER, 1931, Univ. of Texas, Bull. 3101, p. 202.

Planulina taylorensis CUSHMAN, 1931, Tenn. Geol. Surv., Bull. 41, p. 62, pl. 12, figs. 5a-c; 1931, Jour. Pal., vol. 5, p. 314, pl. 36, figs. 6a-c.

Test nautiloid, dorsal side somewhat concave, ventral side convex, periphery acute, usually bordered by a rim of clear shell material, slightly lobate; chambers numerous, forming from 2 to $2\frac{1}{2}$ whorls, 11 to 12 in the last coil, curving slightly on the dorsal side, V-shaped on the ventral side with the apex produced and extending to the umbilicus, turning back slightly and successively overlapping; sutures in early stages limbate, especially prominent on the ventral face, last few impressed, distinct; umbilical area on the dorsal side filled by a knob of clear shell material, marked on the ventral face by an irregular mass of the same material; wall coarsely perforate; aperture an elongate opening beginning on the periphery and extending on the ventral side under the

EXPLANATION OF PLATE 44

- FIGS. 1, 2—*Globigerinella voluta* (White), $\times 96$. Specimen from Red Bluff, Locality 105. 1, Side view, showing early coils at center. 2, Periphrasal view, illustrating the aperture.
- 3, 4, 5—*Globotruncana canaliculata* (Reuss), $\times 42$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 3, Dorsal view, illustrating strong limbation of sutures, and lack of convexity on this face. 4, Ventral aspect, showing umbilicus. 5, Peripheral view, illustrating the well-defined double keel and sharply truncate margin.
- 6, 7, 8—*Globotruncana arca* (Cushman), $\times 96$. Specimen from exposure at the mouth of Boguechitto Creek, Locality 106. 6, Dorsal side, showing large beads on sutures. 7, Peripheral view, illustrating double keel and truncate margin. 8, Ventral view, showing umbilicus and well-defined double keel.
- 9, 10, 11—*Globotruncana convexa* Sandidge, n. sp., $\times 100$. Holotype from Red Bluff, Locality 105. 9, Peripheral view, showing convexity of dorsal face, narrow truncation of margin, and sharp edges of chambers around the umbilicus. 10, Dorsal view, illustrating regularly curving sutures, globigerine early chambers, and petalloid later chambers. 11, Ventral aspect, showing large umbilicus, and lobate margin.
- 12, 13—*Globotruncana fornicata* Plummer, $\times 85$. Specimen from Red Bluff, Locality 105. 12, Dorsal view, illustrating finely beaded and strongly curving sutures. 13, Ventral side, showing small umbilicus and truncate margin.
- 14, 15—*Anomalina taylorensis* Carsey, $\times 35$. Specimen from Barton's Bluff, Locality 53. 14, Ventral view, illustrating overlapping flaps of chambers. 15, Dorsal aspect, showing slightly evolute character and central knob.
- 16, 17—*Pullenia quaternaria* (Reuss), $\times 72$. Specimen from Red Bluff, Locality 105. 16, Side view, showing five slightly inflated chambers. 17, Apertural view, illustrating rotund shape of test.



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V-shaped flap of the last chamber into the umbilicus. Diameter of illustrated specimen, 1.0 mm.

Typical specimens of this species from the Taylor formation of Texas, as well as specimens from the Ripley formation in Alabama, definitely have the characteristics of *Anomalina* as defined by Cushman in his 1928 classification,¹⁹ and resemble *Planulina* only in their marked compression. The species is involute ventrally and partially involute dorsally, as provided for in the generic definition referred to, while by the

same authority *Planulina* is defined as an evolute form with the earlier chambers visible from both sides of the test. Also there is a difference in the characteristics of the apertures, the aperture of *Planulina* being at the base of the last chamber at the median line, whereas that of *Anomalina* is ventral in early stages, extending to the periphery in the adult. These characteristics of the genus *Anomalina* are clearly shown in the accompanying illustrations of *Anomalina taylorensis* Carsey from the Ripley at Barton's Bluff, on the Tombigbee (Locality 53). The species occurs abundantly in this formation in Alabama.

¹⁹ Foraminifera, Their Classification and Economic Use, *Cush. Lab. Foram. Research*, Spec. Publ. 1, April, 1928.

VITA

John Roy Sandidge was born at Fort Worth, Texas, on December 15, 1897. His early education was received in the public schools of Fort Worth, and of Wichita Falls, Texas. He entered college in 1916, and attended continuously, with the exceptions of five months which were spent in the U. S. Military service in 1918, until his B.A. degree was obtained at Texas Christian University in 1920. The following year he remained at his Alma Mater as a science instructor and graduate student. During 1921-22 he held a teaching fellowship at Vanderbilt University where work in geology was completed for the M.S. degree. For a period of two years following the sojourn at Vanderbilt he was Professor of Biology and Geology at Erskine College in South Carolina. The years 1924-26 found him occupied as a graduate student at Johns Hopkins University. In the summer of 1925 he was assistant to W. C. Alden of the United States Geological Survey, working on the Physiography and Glacial Geology of Montana and adjacent regions. During 1926-27 he was employed in establishing a Department of Geology at Birmingham-Southern

College. He spent the year 1927-28 at Johns Hopkins University in preparation of the dissertation, and was awarded the Ph.D. degree in June 1928.

During the spring of 1928 he was employed as Paleontologist for the Sinclair Exploration Company, and continues in this capacity. In October 1928 he became a member of the faculty of the Geology Department at Princeton University, where he now has the rank of Assistant Professor. From June to October 1929, he was on leave of absence from these connections in the United States to carry on paleontological investigations in Germany for the North European Oil Company. He is a member of the staff of the International Summer School of Geology of Princeton University, dealing with the geology and paleontology of the Bahama Islands, and participates in the field activities of the Princeton Geological Expedition to Montana. He belongs to the Society of Sigma Xi, Phi Beta Kappa, Gamma Alpha Fraternity, Paleontological Society, Society of Economic Paleontologists and Mineralogists, and American Association of Petroleum Geologists.

